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PROTECTIVE COATINGS FOR GUIDE RAILS

Physical Research Project No. 40
Phase 1

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in cooperation with
United States Department of Transportation
Federal Highway Administration

(This report reflects the views of the authors and not necessarily those of the Federal Highway Administration)

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SUMMARY AND RECOMMENDATIONS

At the request of the Division of Operation and Maintenance, the Bureau of Physical Research initiated a project to determine the most effective means of protecting corrugated beam guide rail on the State highway system. Prior to 1962 when galvanized rail began to be specified, all corrugated beam rail was painted. Annual repainting has been necessary to maintain this rail, which constitutes a sizable expenditure of money and manpower by the Division of Operation and Maintenance.

This research effort consisted of a comprehensive literature review of the subject, a study of experiences of other agencies particularly the New York Thruway Authority and the Michigan State Highway Department and an evaluation of sections of rail coated with a variety of experimental materials installed on New York highways by maintenance personnel.

As a result of this investigation it has been possible to compute the annual cost per foot of the various coatings that proved to be successful. The one shown to be the most economical is hot dipped galvanizing at an annual cost of 10 1/2¢ per foot based on a service life of 10 years using an interest rate of 4% compounded annually.

In view of these findings the following recommendations are considered appropriate:

(1) A program should be undertaken to take down, shop clean, galvanize and re-erect all existing ungalvanized steel corrugated beam guide rails on the State highway system.

(2) This program should be coordinated with the plans to extend and anchor existing guide rail systems to improve their structural performance and make them correspond more closely to present design standards.

(3) When dismantled it is anticipated that many sections of old rail will be found to be badly corroded at the splice lap where it has not been possible to paint. This reduction in effective section may have progressed to the point where the rail will no longer transmit the required tension during severe impact. Such sections should be replaced with new galvanized rail.

(4) The performance of existing "W" beam guide rail can be substantially improved by the use of a 5/16" bolt for the post-rail connection in accordance with current standards. A good opportunity to change to the 5/16" bolt will be afforded as the newly galvanized rail is re-erected. Washers as currently shown on the standard sheet will be necessary on both ends of the bolts because of the size of holes in the existing posts.

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Background

In 1962 the New York State Department of Public Works began to specify galvanized steel for all new guide rail and median barrier construction. Prior to that time specifications required that all corrugated beam steel railing be painted and this rail has required repainting each year to maintain its appearance and protect it from corrosion. The cost of guide rail painting is approximately 14¢/ft and represents a sizable investment in manpower and money by the Division of Operation and Maintenance.

Purpose and Scope

At the request of Mr. Charles Besanceney, Asst. General Supervisor of Highway Maintenance, of the Division of Operation and Maintenance, this project was initiated to evaluate the performance, cost, ease of maintenance and the delineating properties of protective coatings for highway guide rails. The study was to include an investigation of the most economical method of maintaining existing ungalvanized rail and the expected life of galvanized rail which has been specified on all new construction since 1962.

To obtain background information for a working plan, a literature search has been conducted and various states and other agencies having experience in the coatings field have been contacted. Also, field surveys were performed on our existing standard guide rail and a few experimental installations.

Literature Search

A literature search was conducted, to determine the types, cost, and the expected life of the coatings which would be suitable for the protection of highway guide rail. It was found that numerous types of coatings are available, that these coatings vary in quality and cost and that the expected life of these coatings are proportional to the amount of effort expended in preparing the surface over which they are to be placed.

Paints were found to be particularly dependent upon the type of surface preparation. It was found that high quality, high cost paints would fail just as rapidly on a poorly prepared surface as lower quality paints. The life expectancy of paint on highway guide rail ranged from one to three years in most states, although there were reports that some coatings were "expected" to last about 8 years.

Existing Field Installations

This Bureau has been evaluating six types of guide rail coatings in the field. Included are paint, galvanizing, and four experimental coatings. The following is a brief description and performance evaluation of each.

Paint

Painted guide rail is the most common type. It is presently maintained by painting it with pavement marking paint after a minimum amount of surface preparation, usually in the form of hand cleaning. Our observations of this type of coating system have revealed that repainting is required annually. Prior to thier galvanizing program the N.Y.S. Thruway Authority programmed all guide rail for repainting each year.

Galvanizing

Hot dipped galvanizing is performed substantially in accordance with ASTM A-123, requiring a minimum of 2 oz. of zinc/sq. ft. of surface. Observations indicate that the earliest of the galvanized guide rail installations, now about 4 years old, are providing maintenance free protection and should continue to do so for a number of years. The oldest galvanized guide rail on the Thruway shows no signs of rusting after five years. Another installation of galvanized guide rail, in the industrial atmosphere of the Buffalo area, is in excellent condition after four years.

Cor-Ten

Cor-Ten is not a guide rail coating in itself, but rather a high strength-carbon, manganese and vanadium alloy steel from which the guide rail is fabricated. Upon exposure to the atmosphere, this steel forms a thin layer of tight-knit rust which prevents further corrosion. Several guide rails of this type were erected in the Fall of 1963. Observations have shown that this type of steel has required no maintenance for about four years. However, the brown-rust color may not be acceptable to the motoring public.

Hinac

This product has been used primarily as a sign coating and is presently being tested for this purpose in California, Oregon and several other states. The coating must be cured by baking at high temperatures and no method of performing maintenance in the field has been developed. A section of galvanized guide rail, over which Hinac has been applied was submitted for testing and erected in 1964. This coating has performed satisfactorily, however, when last surveyed (February 1967), a few breaks in the coating were evident.

Polyurethane

The Northern Fiberdeck Co. submitted a section of guide rail which has received a factory applied polyurethane type coating. This section of railing was also erected in 1964. Extensive rusting has occurred and portions of the coating have been lifted from the rail to expose the bare metal. Based on our observations, this particular type of coating could not be judged as being maintenance free for a substantial length of time.

Witcogard

This coating is basically a two-component system; a bituminous adhesive base which is top coated with colored ceramic chips. The coating is applied by spraying with special equipment, however, minor repairs may be performed by brushing on the bituminous base and throwing on the ceramic chips by hand.

The two installations which the Bureau has observed are located on the Saw Mill River Parkway and on the N.Y.S. Thruway. On the Thruway, the material was placed over previously painted guide rail which had received a minimum amount of hand cleaning. Due to inadequate surface preparation, and despite the manufacturers claims that his material would adhere to, and prevent further rusting of this type of surface, in approximately three years time, the bituminous coating was lifted from the rail and it was found that the rust had spread beneath the coating. After two years of service on the Saw Mill River Parkway this material is performing satisfactorily and no noticeable defects are evident. The material at this location was also placed over previously painted guide rail, however, the surface was prepared by sandblasting and all traces of rust were removed.

Cost and Service Life

The cost to repaint guide rail on our State and Interstate Routes is not available as our Maintenance Division has only a "lump sum" figure for all guide rail maintenance each year. This figure included monies expended for all operations involved in the maintaining of all types of guide rail, with the exception of median barriers, and included replacing and tightening cables, replacing posts, fittings, sections, cleaning, painting, realigning, etc. Also the lineal footage of beam type guide rail, which requires painting is not separated from the total footage of guide rail which includes the cable type. However, we did find that the cost of the paint alone for guide rail maintenance during the fiscal years 1963-1966 averaged $54,000 annually.

Although the Department does not separate the cost of repainting guide rail, the annual maintenance cost for repainting guide rail on the N.Y.S. Thruway, prior to their galvanizing program, averaged 14¢/lineal ft. We believe this figure should be similar to the Departments expenditure for this item because Thruway guide rail was also hand cleaned and coated with pavement marking paint as is done by our maintenance forces. The New Jersey Turnpike also has reported expenditures of 12-15¢/ft. for the hand cleaning and repainting of their guide rail.

The New York State Thruway Authority reports that the cost of removing, galvanizing and re-erecting guide rail during 1964, 65 and 66 was respectively $0.67, $0.66 and $0.83 per foot total. These figures appear reasonable since guide rail regalvanizing costs in the midwest have been reported as averaging about $0.60 per foot. The Thruway further reports that these figures break down into about 34% labor, 57% galvanizing and 9% equipment. Using the figure for the last year of the Thruway program (83¢/ft.) and their percentage cost breakdown, we can compute that the cost of disassembly, freight and reerection (34%+9%) is about $0.35/ft. and the cost of galvanizing (including cleaning) is about $0.48/ft. A prominent guide rail contractor in Utica states that the cost of cleaning removed rail is about $0.30/ft. and that galvanizing the rail costs about $0.20/ft.

The life expectancy of a galvanized coating is recognized as being approximately 10 years, and this figure has been quoted as high as 15 to 20 years in many instances. In recent correspondence with the Michigan State Highway Department, they report that their galvanized guide rail installations have been in place just over 9 years and that an additional 2-6 years of service is estimated before regalvanizing is required.

Company representatives report that Witcogard costs $0.30 per foot applied. While we have no first hand evidence from which to judge service life, it is estimated that it would be from 6 to possibly 10 years. The producers of Witcogard claim that the surface does not have to be thoroughly cleaned. We have found however that the coating will not perform properly if this is not accomplished. The Thruway experience indicates that sand blasting heavy paint films from guide rails in place is not feasible because the paint is too resilient. In addition, field "sand blasting will not clean the overlapped portion of the rails." Michigan reports that rusting starts in this area and can destroy the rail. It is therefore felt that the rail should be disassembled and shop cleaned if Witcogard is to be applied.

New sections of Cor-Ten or Mayori-R corrugated beam type guide rail cost approximately $1.15 per foot. Under a recently awarded contract to purchase galvanized corrugated beam type guide rail for maintenance purposes, the new rail will be supplied for about $1 per foot.

Annual Cost

All of these costs and expected lives can be reduced to an anticipated annual cost of the various coatings. This has been done in Table 1.

The methods for maintaining existing steel W-Section guide rail listed in the above table are the only alternatives which appear satisfactory at this time. The least expensive program appears to be to remove, clean, galvanize, and reerect the railing. This has the added advantage that rails which have corroded so badly as to be structurally inadequate will be removed from ser-

vice. A program using an expensive coating on rails cleaned in-place would not have this advantage and corrosion would undoubtedly continue in the splice areas.

TABLE 1 - ANTICIPATED ANNUAL COST

Method	Cost Per Foot				Assumed Life (Years)	Equivalent Annual Cost* (per foot)
	Disassemble and Reerect	Clean	Material	Total		
Galvanize	35¢	30¢	20¢	85¢	10	10½¢
New Rail (Weathering Steel)	35¢	—	$1.15	$1.50	15	13½¢
Witcogard	35¢	30¢	30¢	95¢	8	14¢
Paint	—	—	—	14¢	1	14¢
New Rail (Galvanized)	35¢	—	$1.00	$1.35	10	16½¢

* Based on interest rate of 4% compounded annually.

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